How to research your new ingredient for concrete and publish your findings

Claisse, P.A. , Naik, T. , Tyrer, M. and Coupe, S.

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Peter Claisse, Tarun Naik, Mark Tyrer, Stephen Coupe

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The background that we all know

- Cement production gives off a lot of CO_2. Approximately 5% - 9% of the total.
- The secondary materials that can be used in cement can present disposal problems if not used (in the US they may call them “toxic”)
- Mineral extraction to make cement is also a problem. Aggregate extraction is a big problem.
- Poor countries cannot afford to build the homes they need.

The Problem

- Almost half the papers in this conference relate to the use of secondary materials to replace cement
- Almost half the papers submitted to the ICE Materials Journal are on the same subject.
- Nowhere near half of the cement used to make concrete is actually being replaced with secondary materials. There is some progress but it is far too slow. The environment will not wait for us.

Some Reasons for the Problem

- New materials cause production problems and increased cost for producers, e.g. the need for more silos.
- Producers are worried about durability.
- Producers are very worried about leaching and other environmental impacts.
- Producers are very very worried about potential impacts on human health.

Who can we blame?

- Can we say that industry is “risk averse” and “reluctant to invest in new ideas”?
- Can we blame the regulators with their local perspectives on a global problem?
- Can we blame the media with their scare stories and pseudo-science?
- Can we blame the academic system where we have to chase after funding and publications?
- What can we do to get more change?

How do the options compare?

- Power generation: gains are hard to achieve. Every option (wind, tide, nuclear etc.) has problems.
- Transport: many of the gains (e.g. more efficient engines) have already been realised. Not an easy option
- Construction materials (primarily cement) should be the easiest option for reducing CO_2

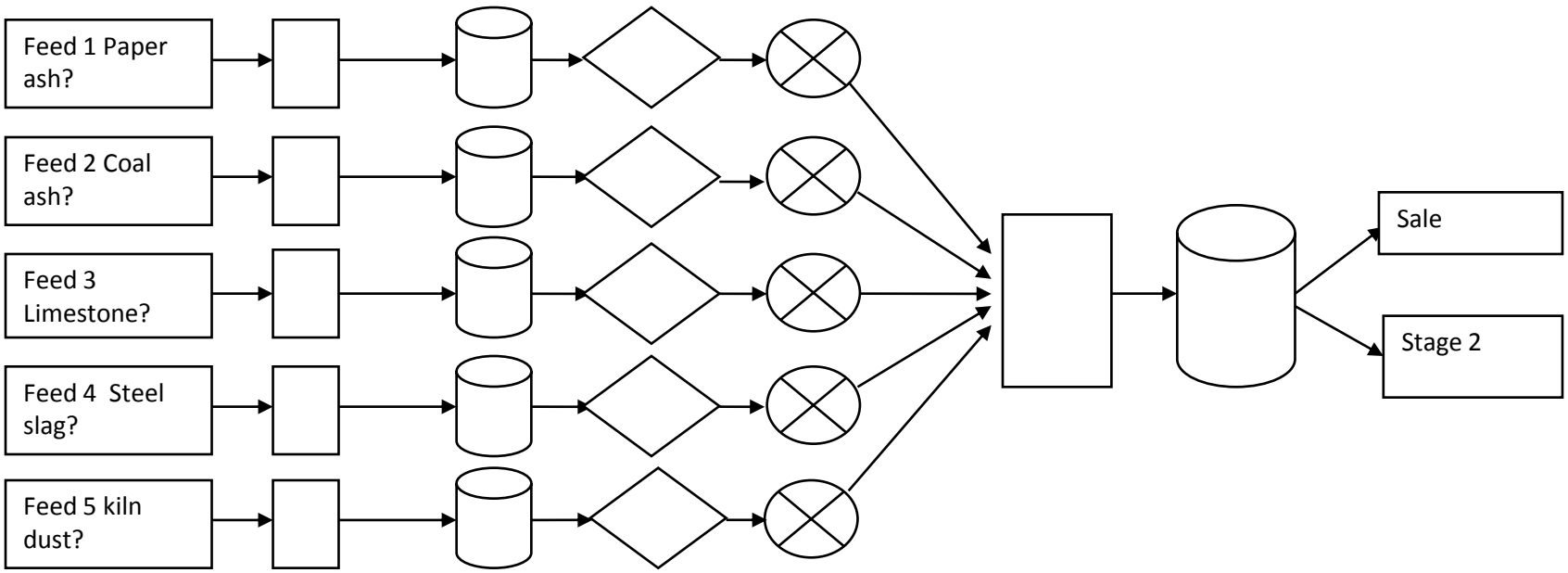
Elements of a Research Programme

- Research objectives
- Materials characterisation
- Pre-treatment
- The basic tests
- Environmental and health impact
- Site trials

Research Objectives

- Define the Product that will be marketed and the application it will be marketed for.
  - A grey powder will be easier to sell than something that looks like a waste.
  - There is clearly a market for low strength cements for house foundations, road sub-bases, trench fill etc. CLSM or CLSM+
  - If the product will be blocks or paving slabs etc. this must be clearly defined at the outset.
- You must explain to your sponsors that they may get a negative result (note that these should be published)

Most products will be blends of several materials



Dryers	Raw material silos	Analysis	Flow control	Mixing	Powder storage
If any of the secondary materials are wet it will be necessary to dry them	The silos should be fitted with agitators to improve uniformity of feed to mixer	In-line X-Ray fluorescence and infra-red spectroscopy for continuous analysis	Responding to results of in-line analysis using computer methods established in this project.	Dry powder and small particle blending	The powder will be dry so it may be stored for weeks /months

Stage 2 may be needed depending on choice of product

Transport from stage 1 silo

Aggregates: Quarry fines, crushed concrete etc.

Mixer

May be a readymix plant or a mobile volumetric mixer

Placement as trench fill, mine backfill, road foundation or other application.

Materials Characterisation

- Must be enough analysis to make the work repeatable in other labs.
- An analysis of the variability of the materials is essential.

Pre-Treatment of Materials

- Grinding, calcining etc. may help but the cost must be calculated.
- Can be useful for converting a “waste” into a “product” to keep the regulators happy.
- Remember to keep archive samples in sealed containers.

The Basic Tests

- Always start with strength.
- Durability tests must be targeted at the chosen applications for the product.

Environmental and Health Impact

- Leaching tests are essential on all products. Even if they will be dry in use they will get wet after demolition.
- Will anybody cut or drill the product? Will the dust be toxic?
- Will the product be used in houses? Might there be trace gas emissions?

Why site trials are needed (1).

- To validate lab results on a large scale
- To demonstrate production methods
- To provide exposure tests for samples which are then returned to the lab

Why site trials are needed (2).

- To provide publicity
- To provide education

Publication

- The introduction
- The discussion

Note that normal good practice, such as adequate reporting of results from control samples and error bars on graphs, is assumed and not discussed here.

The Introduction

- No need to say that replacing cement is a good idea.
- Discuss the availability of the chosen materials.
- Define the product and the applications.

The Discussion

- Compare your product with existing alternatives. Focus on durability.
- If your strength is lower, don’t say this isn’t a problem.
- If one of your materials is sewage sludge ash, discuss the problems with marketing your product.

SCMT 3

Could we ask all contributors to define the impact of their research on CO_2 production?

Is it possible to have a sustainable conference with a positive net environmental impact?

Conclusions – what a paper should have

- An informed discussion of the source of the material including the availability.
- A physical and chemical analysis of the material including estimates of the range of values which might occur in the supply.
- Test results for strength and leaching of the product.
- A report on a site trial.
- An unbiased discussion of the problems which may be expected before the product is brought to market.
- An analysis of the long term consequences of introducing the proposed technology.

Thank you

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Coventry University and The University of Wisconsin Milwaukee

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